

Lesson 1: Modeling Linear Relationships

Classwork

Example 1: Logging On

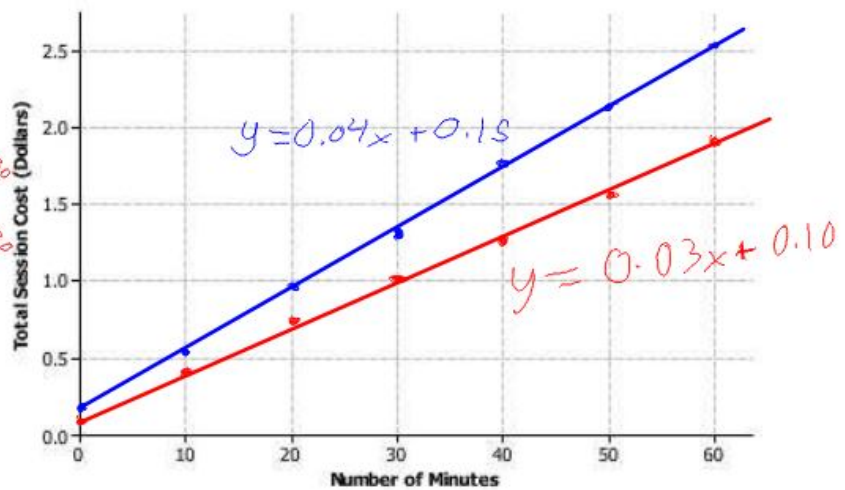
Lenore has just purchased a tablet computer, and she is considering purchasing an internet access plan so that she can connect to the Internet wirelessly from virtually anywhere in the world. One company offers an internet access plan so that when a person connects to the company's wireless network, the person is charged a fixed access fee for connecting, PLUS an amount for the number of minutes connected based upon a constant usage rate in dollars per minute.

Lenore is considering this company's plan, but the company's advertisement does not state how much the fixed access fee for connecting is, nor does it state the usage rate. However, the company's website says that a 10-minute session costs \$0.40, a 20-minute session costs \$0.70, and a 30-minute session costs \$1.00. Lenore decides that she will use these pieces of information to determine both the fixed access fee for connecting and the usage rate.

Exercises 1–6

- Lenore makes a table of this information and a graph where *number of minutes* is represented by the horizontal axis and *total session cost* is represented by the vertical axis. Plot the three given points on the graph. These three points appear to lie on a line. What information about the access plan suggests that the correct model is indeed a linear relationship?
The constant rate is the same (+0.30)

Number of Minutes	Total Session Cost
0	<i>\$ 0.10</i>
10	\$0.40
20	\$0.70
30	\$1.00
40	<i>\$ 1.30</i>
50	<i>\$ 1.60</i>
60	<i>\$ 1.90</i>



2. The rate of change describes how the total cost changes with respect to time.
- a. When the number of minutes increases by 10 (such as from 10 minutes to 20 minutes or from 20 minutes to 30 minutes), how much does the charge increase?

For every 10 mins the charge increases by \$0.30.

- b. Another way to say this would be the "usage charge per 10 minutes of use." Use that information to determine the increase in cost based on only 1 minute of additional usage. In other words, find the "usage charge per minute of use."

$$\frac{\$0.30}{10 \text{ min}} = \frac{x}{1 \text{ min}}$$

$$\frac{10x = 0.30}{10} \quad x = 0.03$$

For every minute, the plan costs \$0.03

3. The company's pricing plan states that the usage rate is constant for any number of minutes connected to the Internet. In other words, the increase in cost for 10 more minutes of use (the value that you calculated above) will be the same whether you increase from 20 to 30 minutes, 30 to 40 minutes, etc. Using this information, determine the total cost for 40 minutes, 50 minutes, and 60 minutes of use. Record those values in the table, and plot the corresponding points on the graph in Exercise 1.

4. Using the table and the graph in Exercise 1, compute the hypothetical cost for 0 minutes of use. What does that value represent in the context of the values that Lenore is trying to figure out?

The initial fee for connecting to the internet is \$0.10 before any minutes are used.

5. On the graph in Exercise 1, draw a line through the points representing 0 to 60 minutes of use under this company's plan. The slope of this line is equal to the rate of change, which in this case is the usage rate.
6. Using x for the number of minutes and y for total cost in dollars, write a function to model the linear relationship between minutes of use and total cost.

$$y = mx + b$$

$$y = 0.03x + 0.10$$

Example 2: Another Rate Plan

A second wireless access company has a similar method for computing its costs. Unlike the first company that Lenore was considering, this second company explicitly states its access fee is \$0.15, and its usage rate is \$0.04 per minute.

$$\text{Total Session Cost} = \$0.15 + \$0.04(\text{number of minutes})$$

$$y = 0.15 + 0.04x$$

Exercises 7–16

7. Let x represent the number of minutes used and y represent the total session cost. Construct a linear function that models the total session cost based on the number of minutes used.

$$y = mx + b$$

$$y = 0.04x + 0.15$$

8. Using the linear function constructed in Exercise 7, determine the total session cost for sessions of 0, 10, 20, 30, 40, 50, and 60 minutes, and fill in these values in the table below.

$$y = 0.04(0) + 0.15$$

$$y = 0.15$$

$$y = 0.04(10) + 0.15$$

$$= 0.40 + 0.15$$

$$= 0.55$$

Number of Minutes x	Total Session Cost y
0	\$0.15
10	\$0.55
20	\$0.95
30	\$1.35
40	\$1.75
50	\$2.15
60	\$2.55

+ 0.40

9. Plot these points on the original graph in Exercise 1, and draw a line through these points. In what ways does the line that represents this second company's access plan differ from the line that represented the first company's access plan?

The new line is steeper and starts higher.

The slope is greater

larger initial fee

MP3 download sites are a popular forum for selling music. Different sites offer pricing that depend on whether or not you want to purchase an entire album or individual songs "à la carte." One site offers MP3 downloads of individual songs with the following price structure: a \$3 fixed fee for monthly subscription PLUS a charge of \$0.25 per song.